REMARKS

The Final Office Action dated March 19, 2004, has been received and reviewed.

Claims 1-4, 7-11, 14-16, and 20-32 are currently pending and under consideration in the above-referenced application. Each of claims 1-4, 7-11, 14-16, and 20-32 stands rejected.

Reconsideration of the above-referenced application is respectfully requested.

Rejections Under 35 U.S.C. § 112, Second Paragraph

Claims 1, 7, and 14 stand rejected under 35 U.S.C. § 112, second paragraph, for reciting subject matter which is purportedly indefinite. Specifically, each of these claims has been rejected for reciting the term "gradually," as it applies to the acceleration of the rate at which a substrate is spun during spin coating processes.

With respect to determining whether relative terms, such as "gradually" are definite, M.P.E.P. § 2173.05(b) provides the following instructions:

> When a term of degree is presented in a claim, first a determination is made as to whether the specification provides some standard for measuring that degree. If it does not, a determination is made as to whether one of ordinary skill in the art, in view of the prior art and the status of the art, would be nevertheless reasonably apprised of the scope of the invention.

We repeat our prior analyses as to why the specification of the above-referenced application provides sufficient guidance as to the meaning of the term "gradually," as used in claims 1, 7, and 14, and of the reasons that one of ordinary skill in the art would readily understand the meaning of the term "gradually," as used in claims 1, 7, and 14.

As noted in the Final Office Action, the specification of the above-referenced application, at paragraph **[0041]**, provides exemplary durations for each spinning speed set forth therein. Specifically, paragraph **[0041]** notes that the rate at which a substrate is spun may be decreased from a first speed of about 1,000 rpm to a second speed of about 100 rpm over a period of about five seconds to about ten seconds. Stated another way, the gradual decrease in the rate of spinnig may occur at a rate of about 90 rpm/sec (900 rpm decrease over ten seconds) to about 180 rpm/sec (900 rpm decrease over five seconds). When compared to the rotational

speeds and nearly instantaneous changes in rotational speed that are described in the prior art (*see, e.g.,* U.S. Patent 6,117,486 to Yoshihara (hereinafter "Yoshihara"), this example provides one of skill in the art with clear guidance as to what is meant by the term "gradually," as that term is used in claims 1, 7, and 14.

Although the Office has concluded that the specification of the above-referenced application does not provide some standard for measuring the degree of the relative term "gradually," when used to describe rates at which spinning of a substrate is increased or decreased, the Office has not fully considered whether or not one of ordinary skill in the art would have nevertheless been reasonably apprised of the scope of the invention.

As for the understanding of one of ordinary skill in the art, the third edition of the American Heritage College Dictionary defines the term "gradual" as "[a]dvancing or progressing by regular or continuous degrees." In view of this definition, it is respectfully submitted that the term "gradually" is a relative term, which is acceptable if one of ordinary skill in the art would readily understand its meaning in light of the specification. *See* M.P.E.P. § 2173.05(b).

Turning now to references in the appropriate art, use of the term "gradual" in claims 1, 7, and 14 becomes even more clear.

Conventionally, the acceleration and deceleration of wafers during spin coating processes have been performed "as quickly as is practical to the final spin speed. Wolf, Stanley, Silicon Processing for the VLSI Era, Volume 1: Process Technology, page 431 (1984) (hereinafter "Wolf"), a copy of which has already been provided to the Office. This is because "[h]igh ramping rates have been shown to yield better film uniformities than low ramping rates." *Id.* U.S. Patent 6,117,486 to Yoshihara (hereinafter "Yoshihara"), on which the Office relies for several of the claim rejections that have been presented in the above-referenced application, notes that in conventional spin coating processes, rotational acceleration and deceleration may be effected at about 10,000 rpm/sec. Col. 10, lines 16-52. Yoshihara also instructs that, in the processes described therein, even quicker deceleration (*e.g.,* at about 30,000 rpm/sec) may be desirable. Col. 12, line 54, to col. 13, line 15; col. 14, lines 28-42. Wolf similarly teaches, "[a] spin-ramp of 20,000 rpm/sec has been suggested as an adequate compromise to provide

maximum coating uniformity" for older, less resist-conservative spin coating methods. Wolf, page 431.

By way of contrast to accelerating or decelerating spinning of a substrate "as quickly as practical," another reference, U.S. Patent 6,251,487 to Yonaha (hereinafter "Yonaha"), provides a nonlimiting example of "gradual" acceleration or deceleration. Yonaha, at col. 7, lines 53-64, indicates that a 4,670 rpm increase (from 1,000 rpm to 5,670 rpm) in the spin rate of a substrate may be effected over a period of two seconds, amounting to an acceleration of 2,335 rpm/sec. Notably, such gradual acceleration is only mentioned by Yonaha in reference to the change between an initial spin speed and an immediately subsequent spin speed. All of the other changes in the rate at which the substrate is rotated lack any reference to a rate of acceleration or deceleration and, thus, must be assumed to be about "as quickly as practical." A copy of Yonaha has already been provided to the Office.

In view of the foregoing, it is evident that "as quickly as practical" includes nearly instantaneous rates of acceleration and deceleration (*e.g.*, 10,000 rpm/sec, 20,000 rpm/sec, 30,000 rpm/sec), while "gradual" rates of acceleration (*e.g.*, 2,335 rpm/sec) are not "as quickly as practical" and consume time that has been conventionally perceived as crucial to forming a uniform film prior to evaporation of solvent from the photoresist.

It is, therefore, respectfully submitted that the meaning of the term "gradual," as it applies to acceleration or deceleration of the rate at which a substrate is rotated, or spun, would be readily apparent to one of ordinary skill in the art of spin coating. Accordingly, it is respectfully submitted that each of claims 1, 7, and 14 complies with the requirements of the second paragraph of 35 U.S.C. § 112 and is in condition for allowance.

Rejections Under 35 U.S.C. § 102(a)

Claims 1-4 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Yoshihara.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single reference which qualifies as prior art under 35 U.S.C. § 102. *Verdegaal Brothers v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). Furthermore, the identical invention must be shown in as complete detail as is

contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). Additionally, the elements must be arranged as required by the claim, but identity of the terminology is not required. *In re Bond*, 15 USPQ2d 1566 (Fed. Cir. 1990).

Yoshihara describes a resist coating method. Resist is applied to a substrate as the substrate is being rotated. The rate at which the substrate is rotated is then decreased for a predetermined period of time. Thereafter, the rate at which the substrate is rotated is again increased. Yoshihara teaches that by spinning a semiconductor wafer at high speeds, lowering the speed for a time, and re-increasing its rotational speed, the wafer can be coated with material in such a way that circular ripples do not appear thereon.

Yoshihara does not, however, expressly or inherently describe that re-increasing the rate of spinning of a substrate may be effected *gradually*. Rather, as indicated in the tables of columns 9 and 10 of Yoshihara, the acceleration and deceleration between different spinning speeds are affected nearly instantaneously—at least 10,000 rpm/sec. It is respectfully submitted that one of ordinary skill in the art would readily recognize that, when a substrate is rotated at speeds that vary from about 0 rpm to about 4,500 rpm, a 10,000 rpm/sec or greater (*e.g.*, 30,0000 rpm/sec) acceleration or deceleration of the rotational speed of the substrate would not be gradual.

For example, when the rate of spinning is decreased from 4,500 rpm to 2,000 rpm, at a rate of 30,000 rpm/sec, as disclosed at col. 9, lines 55-62, and col. 10, lines 8-10, deceleration would be effected for less than one-tenth of a second. This is about three times the deceleration in one-fiftieth to one-hundredth the amount of time as (*i.e.*, occurs about 150 times to about 300 times faster than) the deceleration between first and second speeds noted in the nonlimiting example provided in paragraph **[0041]** of the above-referenced application.

Accordingly, it is respectfully submitted that Yoshihara does not anticipate "gradually increasing a rate of . . . spinning," as recited in independent claim 1. It is, therefore, respectfully submitted that, under 35 U.S.C. § 102(b), independent claim 1 is allowable over Yoshihara.

Each of claims 1-3 is allowable, among other reasons, as depending from claim 1, which is allowable.

Claim 2 is further allowable since Yoshihara lacks any express or inherent description that recesses in the substrate are substantially filled as the substrate is spun at a first speed. Instead, the disclosure of Yoshihara is limited to processes for reducing or eliminating the occurrence of ripples over the surface of a layer of material that has been applied to a substrate by spin coating processes.

Claim 3 is additionally allowance since Yoshihara neither expressly nor inherently describes that, as a rate at which a substrate is spun is decreased to a second speed, material located within recesses of the substrate is permitted to set. Again, the description of Yoshihara is limited to spin coating processes which reduce or eliminate the occurrence of ripples on the surface of a material (*e.g.*, photoresist) layer.

For these reasons, withdrawal of the 35 U.S.C. § 102(a) rejections of claims 1-4 is respectfully requested.

Rejections Under 35 U.S.C. § 103(a)

Claims 1-4, 7-11, 14-16, and 20-32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 5,405,813 to Rodrigues (hereinafter "Rodrigues").

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Rodrigues describes a method which includes spinning a semiconductor wafer at a first speed, decreasing a rate at which the wafer is spun to a second speed, applying photoresist to the substrate while "concurrently decelerat[ing the rate of spinning the wafer] from the first

rotational speed to [the] second rotational speed" (col. 2, line 65, to col. 3, line 5; col. 5, lines 22-47), then increasing the rate at which the wafer is spun to a third speed and further increasing the rate at which the wafer is spun to a fourth speed.

As Rodrigues teaches that photoresist is applied "at a very slow dispense rate" to a semiconductor wafer "during [constant] deceleration of the semiconductor wafer" from a first speed to a second speed (col. 2, line 65, to col. 3, line 5; col. 4, lines 63-68), Rodrigues does not teach or suggest that material is applied to or located on the wafer as the wafer is spun at the first speed. Nor does Rodrigues teach or suggest maintaining the second rotational speed of the wafer once the material has been applied thereto and the second rotational speed has been reached.

Independent claim 1, as amended and presented herein, is directed to a spin coating method which includes applying a material to a substrate, spinning the substrate and the material at a substantially constant first speed, then decreasing a rate of spinning to a substantially constant second speed, followed by gradually increasing a rate of spinning to a substantially constant third speed.

Independent claim 7 recites a spin coating method which includes applying a material to a substrate, spinning the substrate and the material at a first speed that permits the material to flow into recesses formed in the substrate, then spinning the substrate at a second speed that permits material within the recesses to set, and, thereafter, gradually increasing a rate at which the substrate is spun to a third speed.

Independent claim 14 is drawn to a spin coating method that includes applying a material to a substrate, spinning the substrate at a first speed to at least partially spread the material, then spinning the substrate at a second speed to permit at least some of the material to flow into at least on recess formed in the substrate, and, thereafter, gradually increasing a rate of spinning of the substrate to a third speed.

It is respectfully submitted that Rodrigues does not support a *prima facie* case of obviousness against any of clams 1-4, 7-11, 14-16, or 20-32 because Rodrigues does not teach or suggest each and every element of any of claims 1-4, 7-11, 14-16, and 20-32.

Again, with respect to independent claim 1, the teachings of Rodrigues are limited to applying resist to a wafer "*during deceleration of the . . . wafer*" *from a first speed to a second speed.* Col. 2, line 65, to col. 3, line 5 (emphasis supplied); *see also* col. 5, lines 22-47. As noted at col. 4, lines 63-68, photoresist is applied "at a very slow dispense rate" as the rate of rotation of a semiconductor wafer "is constantly decelerating form a very high speed to a very slow speed." Due to this combination of teachings, it is clear that photoresist is not dispensed at a "substantially constant first speed," as required by independent claim 1, but, rather, over an infinite plurality of constantly decreasing speeds. Thus, Rodrigues does not teach or suggest applying resist to a substrate as it is spun at a "substantially constant first speed," as is required by independent claim 1.

Moreover, because Rodrigues teaches that the speed of a wafer is decreased as resist is applied thereto, then apparently immediately increased (as Rodrigues lacks any teaching or suggestion of maintaining the second speed), the rotational speed of the wafer is not "substantially constant" as the wafer is spun at the second speed of Rodrigues.

Even assuming, for the sake of argument, that the second speed of Rodrigues were considered to be analogous to the first speed of independent claim 1, the subsequent third speed of Rodrigues is greater than the second speed. Col. 6, lines 13-17. Therefore, when such an assumption is made, the teachings of Rodrigues are opposite the requirements of independent claim 1; *i.e.,* in Rodrigues, an increase in rotational speed occurs from one speed (*i.e.,* the second speed of Rodrigues) to the next speed (*i.e.,* the third speed of Rodrigues), whereas independent claim 1 requires a decrease from the first speed to the second speed.

Thus, Rodrigues cannot teach or suggest both spinning a substrate with a material thereon at a first speed and the sequence of spinning, decreasing, then increasing the rotational speed of the substrate that are recited in independent claim 1.

Claims 2-4 and 21-24 are each allowable, among other reasons, as depending either directly or indirectly from claim 1, which is allowable.

Claim 2, which recites that material may substantially fill recesses of a substrate as the substrate is spun at a substantially constant first speed, is additionally allowable since Rodrigues neither teaches nor suggests that resist is present on the wafer as the wafer is being spun at the

first speed. This is because the teachings of Rodrigues are limited to the application of resist to the wafer *after* the wafer has been rotated at the first speed thereof. Col. 2, line 65, to col. 3, line 5; col. 5, lines 22-27.

Again, if the second speed of Rodrigues is considered to be analogous to the first speed of independent claim 1, the teachings of Rodrigues with respect to order in which the rotational speed of a wafer is increased and decreased are inconsistent with that recited in independent claim 1. Col. 6, lines 13-17. Thus, when such an assumption is made, there is no need to address the issue of whether or not recesses in the wafer would be filled with resist as the wafer is spun at the second speed taught in Rodrigues.

If it is assumed that the first speed of claim 2 occurs at some instant, frozen in time, between the continual deceleration from the first rotational speed of Rodrigues to the second rotational speed thereof, there could be no flow of material into a recess, as required by claim 2, at an instant that is frozen in time.

Claim 3 is additionally allowable because Rodrigues lacks any teaching or suggestion that, as the rotational speed of a wafer is decreased from a first speed to a second speed, resist within recesses of the wafer may substantially set. To restate: according to the teachings of Rodrigues, there is never resist on the wafer as the wafer is rotated at a first speed. Col. 2, line 65, to col. 3, line 5; col. 5, lines 22-27.

Even if it is assumed that the second rotational speed of Rodrigues is analogous to the first speed recited in independent claim 1, it is respectfully submitted that, by teaching that, as soon as the wafer reaches the second rotational speed, dispensing of resist ceases and the spinning of the wafer is accelerated to a third rotational speed (*see, e.g.,* col. 3, lines 2-10; col. 5, lines 44-46, and col. 6, lines 13-17; Rodrigues teaches the duration at which the rotation is held at the third rotational speed thereof, but includes no such teaching for either the first or second rotational speeds thereof), there would not be time for the resist to set *during* the second rotational speed.

Claim 21 is further allowable since Rodrigues does not teach or suggest *decreasing* a rate of spinning of a substrate to a fourth speed after the rate of spinning of the substrate was increased to a third speed. Rather, the teachings of Rodrigues are limited to increasing the rate of

spinning of a wafer from a second speed to a third speed (col. 6, lines 13-17), then further *increasing* the rate at which the wafer is spun to a fourth speed (col. 6, lines 48-54).

Claim 23, which depends from claim 21, is also allowable because Rodrigues lacks any teaching or suggest that, following decreasing of the rotational speed of a substrate to a fourth speed, the rotational speed of the substrate may again be increased to a fifth speed.

With respect to independent claim 7, Rodrigues neither teaches nor suggests spinning a substrate and material thereon at a first speed that permits the material to flow into recesses formed in the substrate. Instead, Rodrigues teaches a method which includes *very slowly applying* resist to a wafer *after* the wafer has been spun at a first rotational speed, as the rate of rotation is being *constantly decelerated* from the first rotational speed to a second rotational speed. Col. 4, lines 63-68.

As there is no material on the wafer at a first speed, material could not flow into recesses formed in the wafer as the wafer is being spun at a first speed.

If it is assumed that the first speed of independent claim 7 occurs at some instant, frozen in time, between the continual deceleration from the first rotational speed of Rodrigues to the second rotational speed thereof, there could be no flow of material into a recess, as required by independent claim 7, at an instant that is frozen in time.

Again assuming, for the sake of argument, that the second speed of Rodrigues corresponds to the first speed recited in independent claim 7, resist could not flow into recesses of the wafer at the second speed because rotation of the wafer is merely decelerated to the second speed, then apparently immediately increased to a third speed.

Accordingly, Rodrigues does not teach or suggest each and every element of independent claim 7.

Each of claims 8-11 and 25-28 is allowable, among other reasons, for depending either directly or indirectly from claim 7, which is allowable.

Claim 9 is further allowable because Rodrigues cannot teach or suggest both that material is applied to a substrate which is spun at a first speed and, thereafter, the rate at which the substrate spun is decreased. If it is the first speed of Rodrigues that corresponds to the first speed

of independent claim 7, in the method of Rodrigues, resist has not yet been applied to the wafer (col. 2, line 65, to col. 3, line 5; col. 5, lines 22-27), as required by independent claim 7. If, in the alternative, it is the second speed of Rodrigues that corresponds to the first speed of independent claim 7, Rodrigues teaches that the rotational speed of the wafer is *increased* to a third speed (col. 6, lines 13-17), not *gradually decreased* to a second speed, as required by claim 9.

Claim 10, which recites that material may substantially fill recesses of a substrate as the substrate is spun at a first speed, is additionally allowable since Rodrigues neither teaches nor suggests that, as the wafer is being spun at the first or second speed thereof, resist may flow into recesses that are formed in the wafer. With respect to the first speed of Rodrigues, there is not yet any resist on the wafer with which recesses therein may be substantially filled. Col. 2, line 65, to col. 3, line 5; col. 5, lines 22-27. As for the second speed of Rodrigues, at which resist is present on the wafer, Rodrigues lacks any teaching or suggest that the second speed is maintained for any period of time, let alone for a sufficient duration to permit resist to substantially fill recesses formed in the wafer.

Claim 25 is further allowable since Rodrigues does not teach or suggest decreasing a rate of spinning of a substrate to a fourth speed after the rate of spinning of the substrate was increased to a third speed. Rather, the teachings of Rodrigues are limited to increasing the rate of spinning of a wafer from a second speed to a third speed (col. 6, lines 13-17), then further increasing the rate at which the wafer is spun to a fourth speed (col. 6, lines 48-54).

Claim 27, which depends from claim 25, is also allowable because Rodrigues lacks any teaching or suggest that, following decreasing of the rotational speed of a substrate to a fourth speed, the rotational speed of the substrate may again be increased to a fifth speed.

As for independent claim 14, Rodrigues does not teach or suggest spinning a substrate and at a first speed to at least partially spread material thereon. Rather, the teachings of Rodrigues are limited to a method which includes *very slowly applying* resist to a wafer as it is being *constantly decelerated* from a first speed, at which resist was not present on the wafer, to a second speed.

If it is assumed that the first speed of independent claim 14 occurs at some instant, frozen in time, between the continual deceleration from the first rotational speed of Rodrigues to the second rotational speed thereof, there could be no spreading of material, as required by independent claim 14, at an instant that is frozen in time.

Assuming again, *arguendo,* that the second speed of Rodrigues corresponds to the first speed recited in independent claim 14, neither Rodrigues nor the knowledge that is generally available in the art provides any teaching or suggestion that increasing the rate of spinning to the third speed thereof, which corresponds to the second speed of independent claim 14, would permit at least some material to flow into recesses formed in the wafer thereof.

Therefore, Rodrigues does not teach or suggest each and every element of independent claim 14.

Claims 15, 16, 20, and 29-32 are each allowable, among other reasons, as depending directly or indirectly from claim 14, which is allowable.

Claim 15, which recites that material may substantially fill recesses of a substrate as the substrate is spun at a first speed, is additionally allowable since Rodrigues neither teaches nor suggests that, as the wafer is being spun at the first or second speed thereof, resist may flow into recesses that are formed in the wafer. With respect to the first speed of Rodrigues, there is not yet any resist on the wafer with which recesses therein may be substantially filled. Col. 5, lines 22-27. As for the second speed of Rodrigues, at which resist has been applied to the wafer, Rodrigues lacks any teaching or suggest that the second speed is maintained for any period of time, let alone for a sufficient duration to permit resist to substantially fill recesses formed in the wafer.

Claim 16 is further allowable because Rodrigues cannot teach or suggest both that material is applied to a substrate which is spun at a first speed and, thereafter, the rate at which the substrate spun is decreased. If it is the first speed of Rodrigues that corresponds to the first speed of independent claim 14, in the method of Rodrigues, resist has not yet been applied to the wafer (col. 5, lines 22-27), as required by independent claim 14. If, in the alternative, it is the second speed of Rodrigues that corresponds to the first speed of independent claim 14, Rodrigues

teaches that the rotational speed of the wafer is *increased* to a third speed (col. 6, lines 13-17), not *gradually decreased* to a second speed, as required by claim 16.

Claim 29 is further allowable since Rodrigues does not teach or suggest decreasing a rate of spinning of a substrate to a fourth speed after the rate of spinning of the substrate was increased to a third speed. Rather, the teachings of Rodrigues are limited to increasing the rate of spinning of a wafer from a second speed to a third speed (col. 6, lines 13-17), then further increasing the rate at which the wafer is spun to a fourth speed (col. 6, lines 48-54).

Claim 31, which depends from claim 29, is also allowable because Rodrigues lacks any teaching or suggest that, following decreasing of the rotational speed of a substrate to a fourth speed, the rotational speed of the substrate may again be increased to a fifth speed.

In view of the foregoing, it is respectfully requested that the 35 U.S.C. § 103(a) rejections of claims 1-4, 7-11, 14-16, and 20-32 be withdrawn.

CONCLUSION

It is respectfully submitted that each of claims 1-4, 7-11, 14-16, and 20-32 is allowable. An early notice of the allowability of each of these claims is respectfully solicited, as is an indication that the above-referenced application has been passed for issuance. If any issues preventing allowance of the above-referenced application remain which might be resolved by way of a telephone conference, the Office is kindly invited to contact the undersigned attorney.

Respectfully submitted,

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